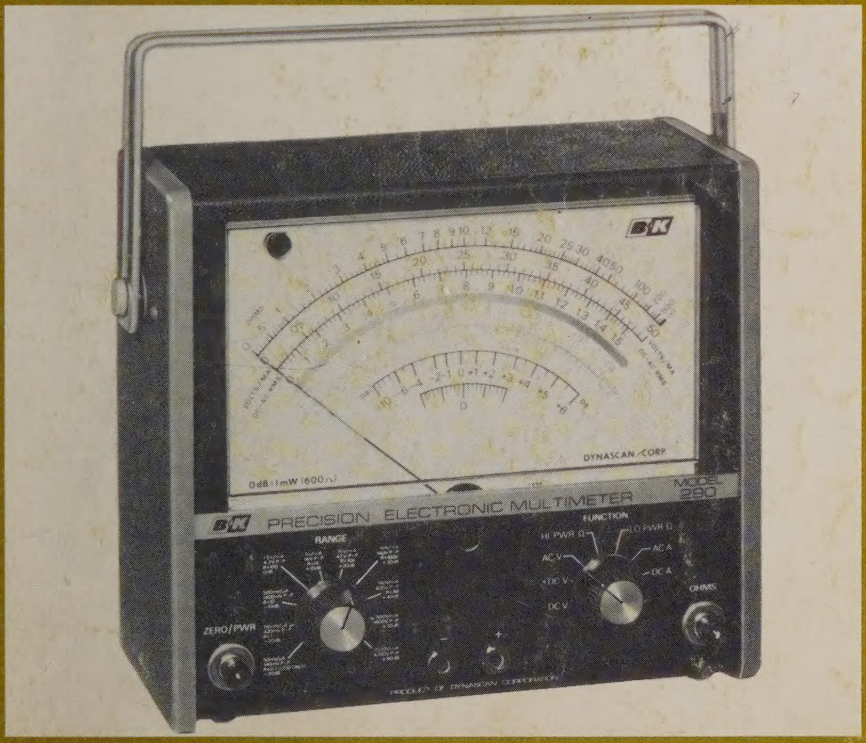
INSTRUCTION MANUAL

B&K Model 290

ROCKFORD INSTRUMENT LAB
1718 Broadway
Rockford IL 61103

EXTENDED-RANGE SOLID-STATE ELECTRONIC MULTIMETER

Highland College



B&K
Product of DYNASCAN CORPORATION
1801 West Belle Plaine Avenue, Chicago, Illinois 60613

Dear Friend:

Congratulations on your purchase of B & K—Precision Test Equipment, and welcome to the B & K family. We hope your experience with your new test equipment will make you a lifetime B & K customer.

Your instrument is backed by more than 20 years of experience in designing and manufacturing. Our most important goal is your satisfaction. At B & K, test equipment is made to meet the demands of the field focusing on dependability and accuracy. We also concentrate on simplicity and operating ease with features that reduce the possibility of human error and speed the servicing process.

In order to determine the type of test units that are needed we have been guided by letters and reports from technicians and engineers who use the equipment daily. Our field tests and studies have helped provide better and faster service techniques. Close contact has been maintained with the manufacturers of consumer products which our test units will be checking and trouble-shooting.

Key personnel in our company cut their eye teeth in the TV service business. This is why we have more "sensitivity" for the problems and conditions under which the test equipment will be used.

B & K product designs are constantly reviewed, and refinements are made or new models developed to meet advances in our industry and to fill your needs. We set our standards high so you can be assured that the B & K test instruments you buy represent advanced design, quality construction, and dependable long-term performance at a price you can afford.

If you have any comments or thoughts about our products, or test equipment in general, I would be delighted to hear from you.

Thanks for your confidence in B & K and we look forward to serving you for a long time to come.

Sincerely,

Carl Korn
President

ROCKFORD INSTRUMENT LAB
1718 Broadway
Rockford, IL 61108

INSTRUCTION MANUAL

FOR

Model 290

EXTENDED-RANGE, AC-OPERATED SOLID-STATE ELECTRONIC MULTIMETER

B & K *DIVISION OF DYNASCAN CORPORATION*
1801 West Belle Plaine Avenue
Chicago, Illinois 60613

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GENERAL DESCRIPTION AND SPECIAL FEATURES

The B & K Model 290 is a solid state FET input Electronic Multimeter ideally suited for radio and TV service technicians, industrial users, engineers and hobbyists.

Its main features include:

- High input impedance (15 megohms) on both AC and DC voltage measurements for minimum circuit loading.
- 50 millivolts full-scale sensitivity on both AC and DC volts.
- Special low resistance ohms range (one ohm center scale).
- Low voltage and normal voltage ohms tests for measuring resistances or for testing IC's, transistors, SCR's, etc. in or out-of circuit.
- Full AC operation (no batteries) with regulated power supplies for ultra stable operation.
- Protection from accidental overloads to meter, FET's and other circuit elements.
- Easy-to-read meter with mirrored scale for making exact measurements.

SPECIFICATIONS

DC VOLTS:

10 Ranges:	50mV, 150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V and 1500V full scale.
Accuracy:	± 1.5% full scale.
Input Resistance:	15 Megohms, ± 1.5% including 100K isolating resistor in probe.
Normal Mode Rejection:	Better than 46 dB @ 60 Hz for ± 2% accuracy change.

AC VOLTS:

10 RMS Ranges:	50mV, 150mV, 500mV, 1.5V, 5V, 15V, 50V, 150V, 500V and 1500V full scale.
10 Peak-to-Peak Ranges:	140mV, 440mV, 1.4V, 4.4V, 14V, 44V, 140V, 440V, 1400V and 4400V full scale.
Input Impedance:	14.9 Megohms shunted by approximately 41pf at input jacks. (140pf with PR-21 Probe).
Frequency Response:	±.5dB, 20Hz to 500kHz to 150V ± 3dB, 5Hz to 750kHz to 150V ± 3dB, 5Hz to 20kHz over 150V
Accuracy:	± 3% full scale @ 60Hz, ± 5% on 500V and 1500V ranges.
Common Mode Rejection:	Better than 40 dB @ 60Hz.

OHMS MEASUREMENT:

8 Low Voltage Ranges (33mV):	RX0.1, RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M.
7 Normal Voltage Ranges (1.25V):	RX1, RX10, RX100, RX1K, RX10K, RX100K, RX1M.
Midscale Reading:	10 (times multiplier)
Accuracy:	±3° of arc, (±4° of arc on RX0.1 and RX1M ranges).

DC CURRENT:

10 Ranges:	50μA, 150μA, 500μA, 1.5mA, 5mA, 15mA, 50mA, 150mA, 500mA and 1.5 Amp full scale.
Accuracy:	±3% full scale; ±4% on 1.5 Amp Range.
Internal Voltage Drop:	50mV at instrument input terminals, to 50mA range.

AC CURRENT:

10 Ranges:	50μA, 150μA, 500μA, 1.5mA, 5mA, 15mA, 50mA, 150mA, 500mA, and 1.5 Amp full scale.
Accuracy:	±4% full scale @ 60Hz, ±5% on 50μA and 1.5 amp ranges.
Internal Voltage Drop:	50mV, at instrument input terminals, to 50mA range.
Frequency Response:	±.5dB, 20Hz to 5kHz, 500uA to 150mA ranges. ±3dB, 7Hz to 16kHz, 500uA to 150mA ranges.

DECIBEL (dB):

10 Ranges:	−40 to +66.
Accuracy:	±3% of full scale.
Reference:	1mW into 600 ohms. (.775V)

RESISTORS:

Multipliers :	½% Precision Type – Frequency-compensated.
Current Shunts:	1% Precision Type
Ohms Shunts :	2% Precision Type

METER:	7", 100μA, ±2%, 100°. DC zero center scale. Mirrored scale.

PROTECTION:	Meter and FET input protected by diode from overloads. Circuit overload protection by fuse (1.25 Amp). High Voltage protection by spark gaps. Power line fuse: 1/16 amp, 3AGSB.
SEMICONDUCTORS:	(1) Dual N-Channel FET. (1) NPN Dual Transistor. (1) NPN Signal Transistor. (1) NPN Low Power Transistor. (2) Germanium Diodes. (2) Silicon Diodes. (4) Silicon Rectifiers (2) Zener Diodes.
POWER REQUIREMENTS:	105 – 125 VAC, 50/60Hz; 3.9 Watts.
DIMENSIONS:	7-1/4" H. x 8" W. x 3-5/8" D.
WEIGHT:	4-1/4 lbs.

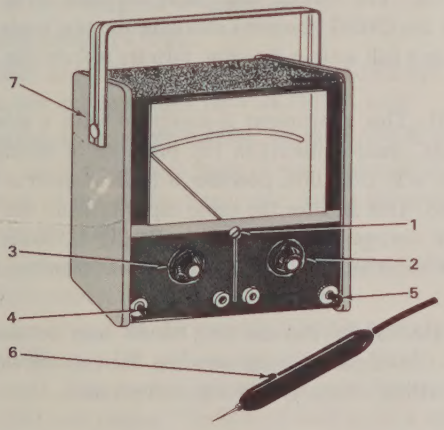


Figure 1. Operating Controls

OPERATING CONTROLS

This Electronic Multimeter is as simple to operate as a conventional VTVM. The following is a brief description of each control and how it is used (refer to Figure 1).

1. METER ZERO ADJUST (MECHANICAL): The mechanical meter zero adjustment must be made before the instrument is turned on. Insert a screwdriver (preferably non-metallic) into the slot located in the center of the front panel immediately below the meter face. While gently tapping meter, very slowly turn the mechanical zero adjust until the pointer rests at zero.
2. FUNCTION SWITCH: Used to select the desired function for the measurements to be performed.
3. RANGE SWITCH: Used to select the desired range of current, voltage, or resistance to be measured.
4. OFF-ON SWITCH AND ZERO CONTROL: To turn the meter on, pull the ZERO control shaft outward. The red lamp on the meter will glow, indicating the meter is ON. Rotate the ZERO control to position the pointer of the meter at zero on the meter scale or to position the pointer on the zero center when using this feature. Push the ZERO control shaft in to turn the meter OFF.
5. OHMS CONTROL: The OHMS control is adjusted with the FUNCTION switch in one of the OHMS positions and with the test leads open. Rotate the OHMS control for a full scale indication, infinity (∞) on the ohms scale of the meter.
6. PROBE SWITCH: This instrument is equipped with a shielded test lead to allow accurate AC measurements in the presence of strong electrical fields. When the switch is in the 100K position, a 100K resistor is switched in series with the test lead. This isolates the cable capacity from the circuit under test when making DC voltage measurements in RF, IF or sweep circuits. Set the probe switch to the DIRECT position for all measurements other than DC voltage.
7. ADJUSTABLE HANDLE: The carrying handle may be used to support the instrument in a convenient sloping position for easy viewing. The case also can be placed in either a vertical or horizontal position.

OPERATING THE MODEL 290

SAFETY PRECAUTIONS

A certain amount of danger is always present when working on electrical equipment and therefore, the user is cautioned to always familiarize himself as much as possible with the equipment to be tested, before any work is performed. It should be kept in mind that high voltages often appear at unexpected points in defective equipment.

When testing high voltage circuits, develop the habit of keeping one hand in your pocket to minimize the hazard of accidental shock. It is also important to have a properly insulated floor or floor covering to stand on while taking measurements. Be particularly careful to avoid contacting nearby objects which could provide a ground return path. A good practice is to remove operating power before connecting test leads. AN ISOLATION TRANSFORMER SHOULD ALWAYS BE USED IN EQUIPMENT HAVING THE CHASSIS TIED TO ONE SIDE OF THE A-C POWER LINE.

1. PREPARATION FOR MAKING MEASUREMENTS:
   a. With the ZERO control knob pushed in (meter in the OFF position), check to see that the meter pointer rests over the zero mark on the left side of the scale. If the pointer is off zero, reset the meter zero adjust (mechanical, as explained under OPERATING CONTROLS).
   b. Insert the double banana plug of the test lead assembly into the meter terminal receptacles so that the positive (+) pin of the plug is in the red (+) terminal.
2. MEASURING DC VOLTAGES:
   a. Turn the FUNCTION switch to the –DC V or +DC V position, depending on the polarity of the voltage to be measured.
   b. Set the PROBE switch to 100K.
   c. Pull the ZERO control shaft outward and rotate ZERO control until meter pointer rests over the zero mark on VOLTS/MA scale.
   d. When measuring an unknown voltage, set the RANGE switch fully clockwise.
   e. Connect the black (negative) lead of the test lead assembly to ground or reference point of the circuit under test. Bring the probe tip in contact with the point to be measured.
   f. Observe the instrument reading; if the meter pointer deflects to the left, set the FUNCTION switch to the correct polarity.
   g. The DC voltage is read on the two black scales just above the mirrored scale on the meter. The top DC scale is used with the 50mV, 500mV, 5V, 50V and 500 Volt ranges. The second DC scale is used for the 150mV, 1.5V, 15V, 150V and 1500 volt ranges. The 0 to .5 volt scale is read directly for the .5 volt range, and is multiplied by .1, 10, 100 and 1000 for the 50mV, 5V, 50V and 500V ranges respectively. The 0 to 1.5 volt scale is read directly for the 1.5 volt range and multiplied by .1, 10, 100 and 1000 for the 150mV, 15V, 150V and 1500 volt ranges respectively.
3. ZERO CENTER DC VOLTAGES:
   a. Set the FUNCTION switch to +DC V and short the test leads together.
   b. Rotate the ZERO control knob clockwise until the meter pointer rests over the center zero mark (the bottom scale).
   c. Set the PROBE switch to 100K.

d. Set the RANGE selector switch fully clockwise and connect the test leads to the circuit the same as for DC voltage measurement.

e. Observe the meter pointer indication on the black scale marked "O" and rotate the RANGE switch counterclockwise to obtain the best useable meter deflection. Positive voltages will make the pointer deflect to the right of the center zero mark. Each side of the scale represents one-half of the range being used. For example, when the .5 volt range is being used, each half of the scale represents .25 volt and each division .01 volt. The purpose for the center zero scale is to indicate a balanced condition. For example, if this instrument is used in the alignment of an FM discriminator, the desired balanced condition will result in a reading of zero on the meter. A misaligned condition will cause some deflection in either the positive or negative direction.

4. MEASURING AC VOLTAGES (RMS & P-P):

NOTE

Effect of waveform in measuring AC voltages: This instrument employs a peak-to-peak type detector, and is calibrated using a sinusoidal signal. The scale is calibrated to give RMS readings, using effective values based on a true sinewave. When it is known that other than sinusoidal signals are being used, it must be recognized that the accuracy as specified for sinusoidal waveforms will not apply. However, peak-to-peak values will remain accurate using the peak-to-peak scales on the meter.

a. Set the FUNCTION switch to the AC V position.

b. Set the PROBE switch to DIRECT.

c. Set the RANGE switch to the desired position. If the voltage is not known, set RANGE switch fully clockwise.

d. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on VOLTS/MA scale.

e. Connect the black (negative) lead of the test lead assembly to the chassis or reference point of the circuit under test.

f. Bring the tip of the probe in contact with the point in the circuit where the voltage is to be measured.

g. Observe the meter indication. RMS voltage is read on the two red scales just below the mirrored scale on the meter. To measure peak-to-peak voltage, the two red scales marked VOLTS P-P are used. The scale readings are multiplied by the same multiplier factors as were used in DC voltage measurements.

5. dB MEASUREMENTS:

The dB scale (−10dB to +6dB) for measuring output level is calibrated according to the standard of 1mW into 600 ohms and direct scale readings

apply with the RANGE switch in the 1.5V position (0dBm). The ten AC V ranges are in 10dB steps, so that starting from "0dB" on the 1.5V range, add 10dB for each range above 1.5 volts and subtract 10dB for each range below 1.5 volts. All dB measurements are a measure of the ratio between the voltage in the circuit under test and the standard reference level indicated above. If the impedance across which the measurement is taken is other than 600 ohms, use Figure 2 to determine actual power level with respect to 600 ohm reference. The chart in Figure 3 can be used to determine the power being dissipated in a circuit if the circuit impedance along with either the applied voltage, or the dB is known. This chart also shows the relationship of AC volts to dB.

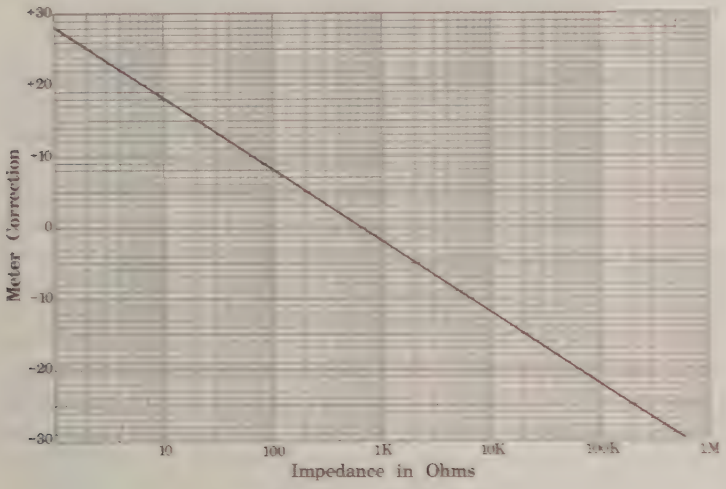


Figure 2. DB Correction Chart

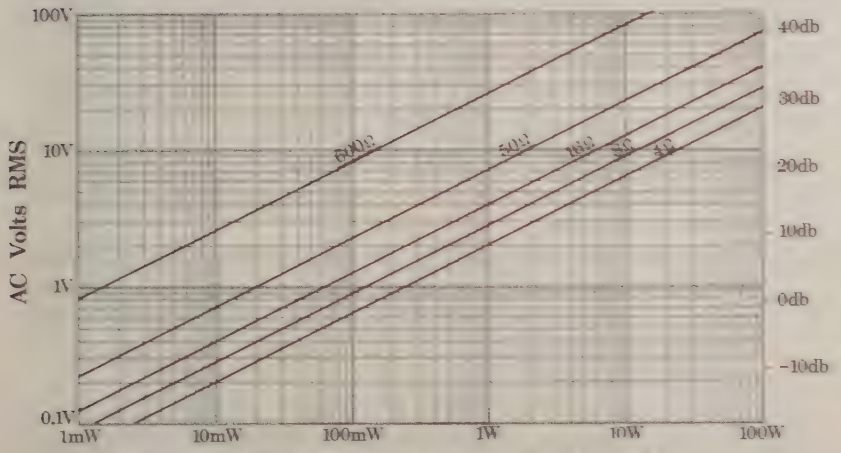


Figure 3. Voltage vs. Power Chart (Sine Wave Conditions Only)

NOTE

The dB scales of this meter and the charts in Figure 2 and Figure 3 only apply when the voltage being measured is a pure sine wave. Complex waveforms such as those encountered in music material will not give a true RMS reading for the dB system to be accurate, however, the dB scales can be used for relative level measurements.

6. MEASURING RESISTANCES:

CAUTION

When making resistance measurements be sure that the power to the equipment under test is disconnected. If voltage is accidentally applied to the ohms ranges, fuse replacement may become necessary.

a. **Hi Ohms Measurements.** To measure resistance, set the FUNCTION switch to the HI OHMS position, and the RANGE switch to the range that will put the resistance to be measured as close to the center of meter scale as possible. When the FUNCTION switch is placed in the OHMS functions, the meter pointer will move from the left hand edge of the meter (zero) to the infinity (∞) mark on the right hand side of the meter. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on ohms scale. Remove short from test leads and rotate the OHMS control to adjust the meter pointer to exactly the infinity (∞) mark on the right hand side of the meter. Be sure that the probe switch is in the DIRECT position. When using the HI OHMS function in solid state circuits, the applied 1.25 volts will be high enough to cause diodes or transistors to conduct. On all resistance ranges, the probe tip is positive with respect to the minus (–) test lead. Remember this when checking components which have a different forward and reverse resistance such as semiconductors and electrolytic capacitors.

b. **Checking for Triggering of Low-Power Silicon-Controlled Rectifiers (SCR):** Low-power SCR's can be checked to see if they can be triggered to the ON condition. To make this check, proceed as follows:

(1) Set the FUNCTION switch to HI OHMS and the RANGE switch to RX1.

(2) Adjust OHMS control so meter reads full scale (∞).

(3) Set the PROBE switch to the DIRECT position.

(4) Connect Minus (–) test lead to the cathode of the SCR and the Plus (+) test lead to the anode.

(5) If the SCR is good, the meter will continue to read ∞. Now momentarily short the SCR gate lead to anode lead. The meter should read a very low resistance, indicating that the SCR has been triggered and is conducting. Removing voltage from the anode lead of the SCR will return it to the non-conducting condition.

c. **Lo Ohms Measurements.** The LO OHMS function is used to make resistance measurements in solid state circuits when the forward conduction of a diode or transistor junction can cause an objectionable error. When using this

function, only 33 millivolts (.033 volt) is applied to the circuit being measured (42 millivolts on RX0.1 Range). This is well below the conduction threshold of silicon and germanium semiconductor junctions. The resistances measured with this instrument in the LO OHMS function will only be the resistance of the circuit components connected to the transistor or diode, and will not be affected by the semiconductor device.

NOTE

The following checks can be made on IC's using the HI-LO OHMS functions of this instrument:

The resistor values within the IC can be measured using the LO power ohms function to determine if the resistor values have changed due to overloads. Transistors and diodes within the IC can be checked for leakage using the LO power ohms function and a high resistance range such as RX1 meg. Substrate leakage of an IC can be checked by using a high resistance range such as RX1 meg and the HI power ohms function. Front-to-back ratio of transistors and diodes can be measured by using the HI power ohms function and reversing the test leads.

NOTE

If the transistor or diode within the IC is shunted by resistances, the highest of the two readings taken (by reversing the test leads) is the equivalent resistance value of the resistors within the IC.

Many other measurements can be made if a schematic diagram of the IC is used.

d. **Very Low Resistance Measurements**: Very low resistance measurements without damage to semiconductors or components can be made using the RX0.1 LO OHMS range. Only 42 millivolts is applied to any device under test on this range. Uses for this resistance range are many. Some typical applications are listed below:

Resistance wire measurements.
Coil windings.
Transformer windings.
Wirewound resistors.
Switch contact resistance.
Cold resistance of lamps.
Fuses.
Heavy wire measurements.

To make resistance measurements on this range proceed as follows:

NOTE

Do not use test leads for making resistance measurements on this range, as an error in readings will result.

(1) Set the FUNCTION switch to LO OHMS.
(2) Set the RANGE switch to RX0.1.

(3) Connect a short heavy gauge wire between the plus and minus jacks and adjust ZERO control until pointer rests exactly over zero mark on OHMS scale.

(4) Remove short from test jacks. The meter pointer will move from the left hand edge of the meter (Zero) toward the infinity (∞) mark on the right hand side of the meter. Rotate the OHMS control to adjust the meter pointer to exactly the infinity mark.

(5) Repeat ZERO and OHMS adjustments at least one more time to obtain the best accuracy.

(6) Make solid connections between test jacks and device being measured and read resistance on OHMS scale (if device has no leads, use short heavy gauge wire).

(7) Multiply resistance reading by 0.1. For example, if the meter reads 10 ohms (center scale) the resistance being measured will be 10 x 0.1 = 1 ohm.

NOTE

It will be necessary to readjust the OHMS and ZERO controls when returning to the higher Ohms ranges.

e. **Measuring Resistance of Thermistors**: The LO OHMS function should be used for making accurate measurements of resistances of thermistors of low resistance value. If this measurement is made in the HI OHMS function, a changing resistance reading will result due to heating caused by the higher current flow through the thermistor. The thermistor should not be held in the hand and should be kept away from any other heat to obtain the most accurate resistance indication.

7. MEASURING AC CURRENT:

a. Set the FUNCTION switch to the AC A position.

b. Set the PROBE switch to DIRECT.

c. Short test leads together and rotate ZERO control until meter pointer rests over zero mark on VOLTS/MA scale.

d. Set RANGE switch to the desired range. If the approximate value of current flowing within the circuit is not known, set the RANGE switch to the 1.5A position and work down toward the 50μA range until an accurate reading is obtained.

e. Turn the power to the equipment under test OFF and open the circuit in which you wish to measure current flow. Connect the ground lead of the test lead assembly to one side of the circuit. Connect the tip of the probe to the other side of the circuit under test.

f. Turn the power to the equipment under test ON and observe the meter pointer deflection. Set the RANGE switch to obtain the most accurate indication (nearest to full scale). AC current is read on the two red scales just below the mirror scale on the meter.

8. MEASURING DC CURRENT:
   a. Set the FUNCTION switch to DC A.
   b. Set the PROBE switch to DIRECT position
   c. Short test leads together and rotate ZERO control until pointer rests over zero mark on VOLTS/MA scale.
   d. Set the RANGE switch to the range desired. If the approximate value of current flowing within the circuit is not known, turn the RANGE switch to the 1.5A position and work down toward the 50μA range until an accurate reading is obtained.
   e. Open the circuit in which you wish to measure current flow. Make sure that meter is inserted in series with the load in which the current is being measured. Do not connect the meter in parallel with the voltage source connected to the load. A severe current overload will blow the fuse. Connect the ground lead of the test lead assembly to the negative side of the circuit. Connect the tip of the probe to the positive side of the circuit under test.
   f. Turn the power on in the circuit under test. Observe the meter pointer deflection. If the pointer is deflected to the left the current polarity is opposite of that which was anticipated. Reverse the test leads and the meter will read up scale. DC current is read on the two black scales just above the mirror scale on the meter.

9. MEASURING DC CURRENTS BELOW 50μA: Reverse leakage current of transistors or diodes can be measured accurately with this instrument at the specified reverse voltage for the device. To make this measurement connect a 100,000 ohms, 5% or better precision resistor across the instrument input terminals. Connect diode or transistor in series with the positive (+) lead and an external power supply voltage. Connect negative (–) lead to minus on power supply.

NOTE

Diode or transistor must be connected in the reverse direction to make a reverse leakage measurement.

Set the FUNCTION switch to +DC V position and the RANGE switch to 1.5V/MA. Increase voltage from the external supply to that specified for the device to be tested. Read leakage current on the two black scales just above the mirrored scale on the meter. Full scale indications are as follows:

Range Switch Position	Full Scale DC Current
1.5V/mA	15μA
500mV/mA	5μA
150mV/mA	1.5μA
50mV/mA	.5μA

NOTE

When measuring current higher than 1.25 Amps, limit measurement time to less than 5 minutes, or fuse replacement may become necessary.

CALIBRATION AND MAINTENANCE

The calibration, bias and balance adjustments have been carefully and accurately adjusted at the factory, and they should not require readjustment unless components have been replaced or these adjustments have been disturbed. If, for any reason, recalibration becomes necessary, carefully perform the following procedures as required.

CALIBRATION OF THE 290 (SEE FIGURE 4 FOR ADJUSTMENT LOCATIONS): To gain access to the calibration adjustments it will be necessary to remove the back from this instrument. To remove the back cover, remove the two (2) screws located at the bottom rear and the two (2) screws at the rear near the top of the cover. After the screws have been removed, tilt the bottom part of the back cover outward (away from rear of unit) allowing the line cord to slide through opening and then gently lift the back cover up and away from the top portion of the front panel. Adjustments must be made in the order indicated below:

BIAS ADJUSTMENT: Connect an external voltmeter between + meter terminal and common ground (foil ground, common jack, etc.). Set the ZERO control so meter pointer rests over zero mark on VOLTS/MA scale. Adjust Bias adjustment (R53) so that external meter reads ~~6.5 volts~~ 6.5 Milivolts.

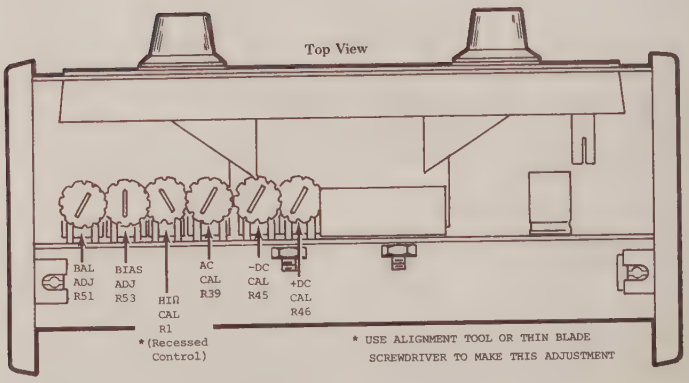


Figure 4. Adjustment Locations

BALANCE: The balance adjustment must be set to obtain the following results:

1. Slowest movement of meter pointer through zero (at left end of meter scale) when ZERO control is rotated.
2. An indication of .3 or higher on the 0 to .5 volt scale with ZERO control set fully clockwise.

To adjust the Balance adjustment, set the RANGE switch to the 1500 volt range, the FUNCTION switch to +DC V and the Balance adjustment to ½ rotation. Rotate ZERO control to ½ rotation and readjust Balance adjustment until meter reads zero. Rotate ZERO control fully clockwise. Meter pointer must indicate .3 or higher on 0 to .5 volt/mA scale. Readjust ZERO control for zero and closely observe movement of pointer through zero at left end of meter scale. If pointer movement appears to be too rapid, adjust Balance adjustment to obtain slowest movement of pointer through zero.

–DC VOLTS CALIBRATION: First check the setting of the mechanical and electrical zero adjustments. Set the RANGE switch to the 500mV range, and the FUNCTION switch to the - DC V position. Set the Probe switch to the 100K position. Apply exactly 0.5 volt DC to the input terminals and adjust -DC Cal Pot (R45) for exactly a .5 indication on the 0 to .5 VOLTS/MA scale.

+DC VOLTS CALIBRATION: Set FUNCTION switch to the +DC V position. Apply exactly 0.5 volts DC to the input terminals and adjust +DC Cal Pot (R46) for exactly .5 indication on the 0 to .5 VOLTS/MA scale.

AC VOLTS CALIBRATION: First check the setting of the mechanical and electrical zero adjustments. Set the RANGE switch to the 50mV position, and the FUNCTION switch to the AC V position. Set the Probe switch to the DIRECT position. Short the test leads together and zero meter. Apply exactly a 0.5 volt RMS sine wave (60Hz) to the input terminals and adjust AC Cal Pot (R39) for a .5 indication on the meter 0 to .5 VOLTS/MA scale.

NOTE

Calibration accuracy is dependent on accuracy of the calibrating source.

HI OHMS CALIBRATION: Set the FUNCTION switch to the LO OHMS position and the RANGE switch to the RX100 position. Set the Probe switch to DIRECT. Short test leads together and adjust ZERO control for exactly zero at left hand side of meter scale. Open test leads and adjust OHMS control to exactly infinity (∞) at right hand side of meter ohms scale. Set FUNCTION switch to HI OHMS and without touching Ohms control adjust HI OHMS Cal (R1) so that meter reads exactly infinity (∞).

REMOVING THE INSTRUMENT FROM ITS CASE: To gain access to the printed circuit board and for general servicing, the case (end pieces) must be removed from the front panel.

To remove the case, first remove the cover (see instructions under "Calibration and Maintenance"). Next, remove the two screws from the tie bar located at the top rear, just above the meter. Rotate the handle down toward the bottom rear of the instrument. Gently pull end pieces outward (sideways) and away from front panel. Lift end pieces up and away from front panel.

To remove the printed circuit board from the front panel, proceed as follows:

1. Remove the two (2) screws at the bottom rear of the unit that holds the transformer bracket in place.
2. Remove the two (2) large control knobs and control nuts on the front panel.
3. Slide the top portion of the meter back (away from front panel).
4. Remove the two (2) large meter retaining nuts located at approximately the center of the P.C. Board.
5. Remove the meter from the front of the P.C. board. Sufficient lead length is provided to allow servicing of the P.C. board components.

OVERLOAD PROTECTION: This instrument is protected against accidental overloads on all functions and all ranges. The voltage ranges are protected because the high input impedance limits the amount of voltage and current applied to the gate of the FET. On the resistance and current functions, the fuse F1 and diode D1 protect both the meter movement and the circuitry. This fuse should be replaced with one of the same type so that the protection feature and accuracy of this instrument are not affected. Accuracy of the RX0.1 range will be most affected by using an incorrect fuse type.

CIRCUIT DESCRIPTION

The Model 290 Electronic Multimeter uses a balanced bridge impedance converter consisting of a dual field effect transistor and a dual bi-polar transistor. This circuitry provides high input impedance and excellent stability.

When making DC voltage measurements the DC voltage is applied thru R11 to the voltage divider (R36 through R27). The RANGE switch S2B selects the required input voltage to be applied to the input gate of Q3A. The FET Q3A provides the necessary high input impedance, and drives the base of Q4A.

Q4 operates as a stable differential amplifier with the meter connected between the collectors. The base of Q4A is driven by Q3A for DC volts, ohms, and for DC current measurements. The base of Q4B (the 2nd half of the differential pair) is driven by Q3B for AC voltage and current measurements. This half of Q3B is in turn driven by the peak-to-peak detector, D8 and D9. In the DC volts, ohms and DC current functions, the peak-to-peak detector does not receive a signal from Q3A because of an AC rejection filter (R8, C4).

The dual FET and dual transistor are independent of temperature effects because they are small TO-71 and TO-78 packages and very little temperature differential can exist between sections.

In the resistance measurement function, a standard resistor is placed in series with either a 33mV or 1.25 volt source and the voltage is applied to the gate of Q3A. The meter will read up scale with this arrangement and the OHMS control allows adjustment at exactly full scale (∞). If the test leads are shorted together, the gate of Q3A will be shorted to ground and therefore receive no voltage. The meter then reads zero ohms. If a resistor between zero ohms and infinity resistance is placed between the test leads, the gate will receive a voltage proportional to the resistor ratios (internal standard and measured resistor) and the meter will indicate the resistance on the OHMS scale. If the resistance being measured is equal to the standard internal resistance of this instrument exactly one half of the voltage will be applied to the gate and the meter will read half scale. Voltages for both OHMS functions are obtained from a well regulated and filtered power supply.

The 33 millivolts for the LO OHMS function is developed across a voltage divider R67, R68, and R69, and applied directly to the gate of Q2A thru a standard resistor. With more IC's and transistors being used everyday the LO OHMS function of this instrument is a must for making resistance measurements in solid state circuits.

When making AC measurements the AC rejection filter is switched out and AC is applied to the same divider as is used for DC voltage measurements. However, capacitors across the divider now provide frequency compensation on all ranges. Therefore, all frequencies between approximately 30Hz and 250KHz are attenuated equally in this divider when switching ranges. The differential amplifier provides AC gain and the peak-to-peak detector develops a negative voltage dependent on the peak positive and the negative voltage swing of the input voltage fed to it. The gate of Q3B receives the detected signal, applies it to Q4B which in turn drives the

meter. Any DC voltage which would normally be applied to the gate of Q4B is shorted out in the AC volts functions by the switch.

When measuring current, a standard resistor is selected by the RANGE switch and put in series with the circuit to be measured. The voltage (AC or DC) develôped across the standard resistor is then measured and read as current on the meter. The fuse F1 protects low value resistors which are more susceptible to burnout. Fuse protection is not required on high resistance value resistors. The meter movement itself is protected on all ranges because it is isolated thru the impedance converter.

WARRANTY SERVICE INSTRUCTIONS

1. Refer to the maintenance section of the instruction manual for adjustments that may be applicable.
2. Defective parts removed from units which are within the warranty period should be sent to the factory, prepaid, with model and serial number of product from which removed, and date of product purchase.
3. If the above mentioned procedures do not correct the difficulty, pack the product securely (preferably double packed). A detailed list of troubles encountered must be enclosed as well as your name and address. Forward prepaid (express preferred) to the nearest B & K authorized service agency.

Contact your local B & K Distributor for the name and location of your nearest service agency, or write to:

Service Department

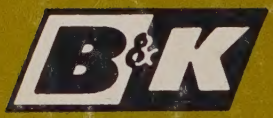
B & K DIVISION OF DYNASCAN CORPORATION

2815 W. Irving Park Rd.

Chicago, Illinois 60613

WARRANTY

"B & K warrants that each product manufactured by it will be free from defects in material and workmanship under normal usage and service for a period of one year after its purchase new from an authorized B & K distributor. Our obligation under this warranty is limited to repairing, or replacing any product or component which we are satisfied does not conform with the foregoing warranty and which is returned to our factory or our authorized service contractor, transportation prepaid, and we shall not otherwise be liable for any damages, consequential or otherwise. *The foregoing warranty is exclusive and in lieu of all other warranties (including any warranty of merchantability), whether expressed or implied.* Such warranty shall not apply to any product or component (i) repaired or altered by anyone other than B & K or its authorized service contractor (except normal tube replacement) without B & K's prior written approval; (ii) tampered with or altered in any way or subjected to misuse, negligence or accident; (iii) which has the serial number altered, defaced or removed; or (iv) which has been improperly connected, installed or adjusted otherwise than in accordance with B & K's instructions. B & K reserves the right to discontinue any model at any time or change specifications or design without notice and without incurring any obligation. *The warranty shall be void and there shall be no warranty of any product or component if a B & K warranty registration card is not properly completed and postmarked to the B & K factory within five days after the purchase of the product new from an authorized B & K distributor.*"



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